BASIC INFORMATION

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Description

The present invention relates to a method of manufacturing prefabricated brick wall panels.

There are many different methods of manufacturing wall panelling, and within the prefabricated building industry these methods are generally well understood. However, only partial success has been achieved in the market-place, the main reason being the high cost of aesthetically acceptable panels.

The purpose of the present invention is to provide a superior, faster, flexible and significantly more economical method of prefabricating brick panel walling suitable for single, multi-storey buildings or other suitable structures.

It is not the intention of this specification to describe different types of brick panel configurations as these will vary from project to project. It is considered that there is already adequate documentation to cover all these variations and this specification concerns itself only with a method of manufacturing a brick panel that is faster and cheaper than has been accomplished before. This method is not restricted to use with clay bricks only and is applicable to cement and silica bricks as well as clay or concrete blocks of varying sizes.

However, panels manufactured for different building types, e.g., industrial, commercial, residential, etc., sometimes require adjustments or additional techniques to the method of manufacture and these are explained below.

While variations in the method of manufacture, where high technology is used to replace some of the more labour intensive ones described in this specification, the basic concept that will enable a superior product to be ecomonically manufactured, will not be altered by these variations in technique. The method is flexible enough to enable manufacture of panels up to 10 metres in height or alternatively 10 metres in length. The method is equally suitable for very low capital costing, semi-mobile manufacturing plants and very large capital intensive plants and is limited only by the market size, not by the market type.

By application of the method it is possible to make solid panels, panels with large or small openings, panels with return end projections or piers on the back, panels of varying shape suitable for detailed architectural designs or panels with dampcourse material as an integral part of the panel itself.

A great failure of the prefabrication industry is that it has not been able consistently to compete efficiently and at various levels of basic or sophisticated methodology with the conventional building methods that offer more flexibility with on-site problems and applications.

For a method to be successful it must meet the following economic criteria:-

a) A simple uncomplicated method of manufacture that can be implemented with low capital investment, speedy establishment and, if necessary, rapid relocation where production runs are very short or if the product produced becomes more detailed and custom oriented.

b) A simple technique for the actual manufacture of the panel element themselves should be utilized, thus enabling semi- and unskilled labour to be quickly trained.

c) It should be compatible with automated techniques that allow, where necessary, the reduction of labour content.

d) The number of operations on site should be limited to a minimum and to allow the easy erection of the elements.

e) It should allow elements to be included such as dampcourse, cavity ties, locating and lifting brackets, etc. and

(f) Importantly it should produce a panel having the appearance of well laid brickwork free from cement contamination on its face.

The present invention consists in a method of making a transportable brick panel consisting of the following steps:

a) Setting out a mould defining the perimeter of a brick panel to be formed, said mould including a substantially flat bottom surface;

b) Laying of a soft deformable membrane over the said surface the membrane being such as to form a seal around the edges of bricks placed on it to prevent fine cementitious particles in mortar placed between such bricks from contaminating the faces of the bricks and such as to inhibit movement of bricks placed on it;

c) Arranging courses of brickwork in said mould on the said membrane; individual bricks being substantially evenly spaced apart for the reception of fluid mortar in the spaces between them;

d) Arranging reinforcing bars to pass through aligned holes in columns of bricks so as to structurally extend through to the top and bottom course or layer of bricks;

e) Pouring fluid mortar to fill spaces between individual bricks and holes in the bricks and allowing it to set,

f) Lifting the brick panel so formed from the mould.

It is preferred that the surface in contact with the bricks be treated with a cement release agent which may be water soluble.

It is further preferred that in some circumstances the membrane has a very thin flexible skin that combines with the membrane to further restrict the passage of fine cementitious particles. It is further preferred to arrange horizontal reinforce-

ment in course bed joints as required.

It is also further preferred in some instances where panels require stiffer characteristics that an extra vertical layer of bricks in the form of a pier be moulded on the back of the panel. It is further preferred that when pouring fluid mortar into the spaces between the bricks constituting the brick pier, a water extraction process be used to solidify mortar and prevent the mortar from draining away from and out of the brick pier.

It is preferred, where required, that a moisture resistant dampcourse be moulded into horizontal joints between courses. It is further preferred that seals or a means of sealing be attached to the reinforcing bars where they penetrate the dampcourse to prevent the passage of moisture.

It is also preferred that the bricks be soaked in water for between 10 minutes and 60 minutes prior to panel manufacture and that their moisture content be not less than 2% by weight. It is preferred in some instances, where required, that the water be heated.

It is preferred that, during brick positioning, where bricks are positioned by hand, the mould be nearly vertical but leaning slightly back and that the bricks be held vertically apart by rod spacers.

It is also preferred that in some instances the mould be split into more than one part to facilitate easier brick placing.

Where door or window openings are required, suitable blockouts are introduced within the brickwork.

In order that the nature of the invention may be better understood and put into practice, preferred forms thereof are hereinafter described by way of example with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a brick panel according to the invention in the course of construction;

Fig. 2 is a cross-sectional view to an enlarged scale of a portion of the panel.

Fig. 3 is an end elevation of the lower part of the panel under construction;

Fig. 4 is a perspective view illustrating the step of introducing mortar into the joints between the bricks;

Fig. 5 is a perspective view of a typical brick panel according to the invention;

Fig. 6 is a detail showing the arrangement of the dampcourse seals on a reinforcing bar;

Fig. 7 is a part-sectional and elevation of a portion of a panel illustrating the location of a dampcourse and seals;

Fig. 8 is a part-sectional and elevation of a portion of a panel illustrating a precast concrete bottom beam with dampcourse;

Fig. 9 is a perspective view of a typical reinforcing detail for a brick panel wall without openings;

Fig. 10 is a perspective view of a large solid panel with brick piers on the back;

Fig. 11 is a perspective view of the dewatering process when moulding brick piers on the back of a panel;

Fig. 12 is a perspective view of a large mould split and hinged to enable brick placing in the folded position; and

Fig. 13 is a perspective view of the mould of Fig. 11 in the open position.

In the manufacture of a brick wall panel, a flat table mould 10 is required, manufactured of any suitable material such as steel or timber and of sufficient size to enable manufacture of the largest panel required.

In Fig. 1 the mould 10 is shown tilted to a near vertical position for the placing of the bricks 13 of the panel by hand as described below. Initially, however, it is placed horizontally.

A membrane 11 and its skin 11a if required (see Fig. 2) is placed upon the mould surface with mould 10 in the horizontal position. The membrane 11 consists of at least a soft, deformable resilient material, e.g., a sheet of soft foam rubber or soft foam plastic for example a flexible cellular polyurethane having an interconnected cell structure of approximately 4mm thickness.

It is preferred that the membrane be stabilised either by attaching to the mould surface or by a skin on at least one of its surfaces which, depending on its type, may be bonded or attached to the membrane. However, if on the upper surface it must have the ability to deform in a co-operative manner similar and imitative of the membrane sufficiently so that under the weight of individual bricks it will assume or maintain the contours and surface irregularities of each brick so as to form a satisfactory seal around each brick to prevent the passage of fine cementitious particles onto the brick face, e.g., a very thin film of flexible plastic attached to the upper surface of the membrane or preferably a porous absorbent fibrous material that will assist the membrane, e.g., a sheet of paper of approximate newsprint grade or an application of wood pulp solution.

It is also preferred that the surface of the membrane or its skin which is in contact with the brick faces be treated with cement retardant preparation or suitable release agent which preferably would be water soluble.

The configuration of the brick panel is set out and defined on its vertical edges by sub-edgeboards 10a. These are fixed in position on the mould 10 as shown in Fig. 1.

A blockout 10c is included where a dampcourse and brick courses beneath it are to be incorporated in the brick panel.

The mould is then raised to a substantially vertical position as shown in Fig. 1, at least within 1° to 15° of vertical so that the bricks 13 rest against the mould. The bricks 13 are then placed face against the membrane 11 and skin 11a (if required) and spaced apart with round rods 13a laid horizontally between each layer of bricks until all the bricks in the panel are in position.

Vertical joints are gauged by eye only and obviously are related to bond and window/door positioning. Window and door openings are positioned prior to positioning the bricks 13 and are in the form of sub-edgeboards 10b, the sub-edgeboards being approximately 10mm in depth thus ensuring a proper dimensional blockout for installation of the actual window or door frames. The mould 10 is then lowered back to an approximately horizontal position.

Reinforcing bars 14 are inserted from the top of the panel through the holes in the bricks until they pass through to what, when the mould was in a near vertical position, was the bottom layer of the bricks. These bars 14 could in some instances be inserted from either end of the panel. In fact, they need not be the same height as the panel. However, any discontinuity of the bar or bars 14 would have to be designed so that when inserted from either the "top" or the "bottom" they lap each other enough (in length) so as to structurally join the panel after curing.

Horizontal reinforcing bars 14A are placed as required in the horizontal bed joints, i.e., between the courses or layers of bricks as shown in Fig. 7.

If a dampcourse is required the following procedure is followed:

A dampcourse upper seal 30 (see Figs. 6 and 7) is attached to the bars 14 and then the bars are passed through the now positioned dampcourse 17 (bottom course 15 only - Fig. 3) whereupon the dampcourse lower seal 31 is attached, thus effectively sandwiching the dampcourse 17 between the two seals. If the reinforcing 14 is inserted from the bottom then the sequence of attachment of the upper and lower seals 30 and 31 is reversed.

Further layers or courses of bricks or precast/in situ reinforced concrete beams (see Fig. 8) or both can then be added to the bottom, i.e., below the dampcourse if required. Bars 14 are then extended into these lower courses or beams.

The reinforcing bars 14 are usually under 12mm in diameter and preferably treated to resist corrosion, e.g., by galvanizing or epoxy coating. This reinforcing varies in size and quantity according to the structural and handling requirements. Reinforcing bars can be located through any of the preformed core holes in the brick and sometimes, depending on diameter, also passing through vertical joints between the bricks. The round rods 13a are now withdrawn and any further horizontal reinforcing 14a required can be placed in position.

Edgeboards (not shown) for the brickwork are now placed in position on the mould 10, preferably with a porous material, e.g. paper, separating the brick end/faces from the edgeboard. When this is complete weepholes if required are blocked out with packing material, e.g., polystyrene, in some of the vertical joints directly above the dampcourse 17.

Because it is important to introduce the liquid mortar directly into the joints between the bricks 13 (the reason for this is so as to generate a cross flow effect when mortar filling, causing air pockets trapped in all the many holes, etc., to be evacuated more efficiently) mortar troughs 19 are placed at various horizontal joint intervals (as shown in Fig. 4) so as to facilitate fast and clean introduction of the mortar into the brick joints.

This "cross flow" effect achieved when pouring the fluid mortar is advantageous as it allows full penetration of all the brick core holes as well as the joints between bricks, making a completely solid panel. The mortar therefore fully embeds all the reinforcing, and allows the panel as a whole to perform similarly to reinforced concrete, the bricks acting like huge pieces of aggregate separating the mortar. Structurally this produces a product that performs in a semi-elastic manner to recover deformations under superimposed loadings. It should be pointed out that this is not normal behaviour for brickwork which is structurally erratic and establishes a structural design criterion for single leaf brickwork that only reinforced concrete has enjoyed before.

This structural effect was confirmed during comprehensive flexural testing of reinforced and unreinforced brick panels. These tests showed reliably similar deformation and recovery performances to reinforced concrete.

The main criterion for the "cross flow" effect to work is the flowability of the fluid mortar. However, the effect of dry porous bricks on the mortar during this operation can be very detrimental. It was realized that in order to prevent the bricks from "soaking up" the free water needed for fluidity in the mortar, the bricks 13 needed to be soaked or saturated. The required quantity of moisture in the bricks 13 at the mortar pouring sequence is gained after immersion in water for between 10 and 60 minutes. A brick that has a total absorption of approximately 8% by weight of dry brick if immersed in water will absorb approximately 4.5% in 10 minutes and approximately 6% in 60 minutes. The bricks 13 should have a moisture content of at least 2% of their total dry weight to ensure that the mortar will flow adequately. It should be noted that this is the water content at the time of introducing